

Spectral Detection of Ammonia Ice in the Turbulent Clouds of Jupiter by Galileo/NIMS

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We report this first spectral detection of ammonia ice in the clouds of Jupiter shortward of 2.5 micron wavelength. The spectral signature of ammonia is uniquely observed within a single, high-altitude cloud feature, imbedded within the turbulent wake region to the northwest of the Great Red Spot (GRS), as recorded in Galileo/NIMS long-map spectral observations on May 3, 1999 during Galileo's 20th orbit. Band depths of about 30% and 50% respectively, are observed for the 1.5 and 1.9 micron ammonia bands. An additional, absorption is also observed near 2.7 micron, a spectral region where ammonia ice has been previously observed in regionally-averaged spectra of jovian clouds (Brooke et al, 1998, *Icarus* 136, 1-13). When spectra of this turbulent wake region feature are ratioed to spectra of nearby GRS clouds located at similar high altitudes, spectral features of homogeneously-distributed gas species such as hydrogen and methane null out, as expected, while the ammonia features remain. We identify these ammonia features as ice features rather than ammonia gas absorptions due to the high altitude of these clouds, some ten kilometers above the ammonia condensation level. In May 1999, the ammonia cloud feature is centered at 15.5 deg. S. planetographic latitude, 260.9 degrees W. longitude, some 7 degrees north and 11 degrees west of the center of the GRS. This is in the vicinity of the same site, relative to the GRS, where clouds of anomalously low 2.73-micron albedo have been observed throughout the Galileo Mission (c.f. Baines et al., 1999, *BAAS* 31, 1134). Concurrent observations made with Galileo/SSI on June 26, 1996 indicates that the ammonia-rich feature is some 3 deg. in latitude and longitude to the northeast of the water cloud observed by SSI (Banfield et al., 1998, *Icarus* 135, 230-250). A working hypothesis is that both the anomalous ammonia and water clouds are freshly-forming clouds of large ice particles, lofted relatively-rapidly above their respective condensation levels by vertical advection and perhaps convection induced by wave motions in the turbulent wake region. The persistence of the 2.73-micron-dark ammonia cloud seen over the Galileo mission indicates that vertical motions are fixed relative to the GRS, and suggests a quasi-stationary wave in the three-dimensional flow around the GRS. The SSI water cloud downstream NIMS NH₃ cloud could then represent the crest of another wave in the now ammonia-dry downstream flow, enabling the deep water cloud to be observed through the clear, ammonia-dry atmosphere

above. In turn, the power liberated by the condensation of water may help maintain the local circulation, including the Great Red Spot itself. In this case the GRS may be a self-sustained system which is largely maintained by the wake-induced condensation of uplifted water vapor generated by turbulent interaction of the GRS itself with the surrounding zonal flow.